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ABSTRACT

Determined was the effect of a community college education on cognitive development of 28 laboratory technology students and 29 liberal arts students. The students were pretested and posttested at the beginning and end of the year, respectively, in two areas of cognitive development: combinatorial logic and proportional logic. For the pretests, the cognitive levels of both groups of students were the same in both combinatorial and proportional tasks. For the posttests, the cognitive levels of both groups were the same for the combinatorial tasks but not for the proportional tasks. The science group did much better on the proportional tasks. Thus, it appears that although a community college education tends to focus on the achievement of specific skills related to a profession, cognitive development does occur. (BB)

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# THE EFFECT OF A COMMUNITY COLLEGE EDUCATION ON THE COGNITIVE DEVELOPMENT OF STUDENTS IN LIBERAL ARTS AND LABORATORY TECHNOLOGY CURRICULA: AN INTERVENTION STUDY

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## ABSTRACT

Most students who enter a community college do so to learn a profession. It is also true that a community college education tends to focus on the achievement of specific skills. But does this type of education help the student to grow cognitively? It is the purpose of this study to answer that question.

In order to answer the above question, two areas of cognitive development were studied: combinatorial logic and proportional logic. Piaget's theory of cognitive development was used as the framework to measure cognitive growth. The sample consisted of male students between the ages of seventeen and nineteen years old who were entering freshman when the study began. Forty subjects were enrolled in the laboratory technology curriculum - a career oriented program, and forty subjects were enrolled in the liberal arts curriculum - a nonscience, general education curriculum for students who wish to transfer to upper division colleges.

Each subject was pretested at the beginning of the semester to obtain a cognitive level in combinatorial logic and proportional logic. Each subject was posttested at the end of the academic year. Twenty-eight laboratory technology students and twenty-nine liberal arts students completed the study. Various hypotheses were tested to

determine if the students in these two curricula were at the same cognitive level at the beginning of the academic year and to see if cognitive growth occurred by the end of the academic year. In this way it could be inferred that college curricula act as interventions to increase cognitive development. Data analysis was performed using Chi-square and other nonparametric statistics.

An analysis of the data showed that for the pretests, the cognitive levels of both groups of students were the same in both combinatorial and proportional tasks. An analysis of the data showed that for the posttests the cognitive levels of both groups of students were the same for the combinatorial tasks but not for the proportional tasks. The science group did much better on the post-proportional tasks than did the liberal arts group. It is argued that this is evidence that cognitive development involving proportional reasoning did occur for those students enrolled in the laboratory technology curriculum. It is further argued that with the proper intervention cognitive development can occur in community college curricula. Finally, implications for community college teaching are discussed.

## INTRODUCTION

It is the goal of the community college to provide the environment and experiences that promote the student's vocational competence, individual growth and social responsibility through the integration of knowledge, proficiency and attitudes. This statement represents the philosophy of most community colleges.

It is true that most students who enter the community college do so to learn a profession. It is also true that a community college education tends to focus on the achievement of specific skills. Does this type of education help the student to grow cognitively? There are several ways of examining cognitive development. Measurement of cognitive level by the methods proposed by Jean Piaget provide a framework by which this question can be answered.

Two areas of cognitive development will be examined: combinatorial reasoning and proportional reasoning. This study will attempt to discover how these two areas of cognitive operations change during the course of a community college education.

The importance of this study is two-fold:

(1) to obtain fundamental knowledge of community college students with regard to their cognitive abilities. Little has been done in this area and it is important to know, after ten years of community college education in New Jersey, what the effect of the community college is on the cognitive ability of its students.

(2) to determine whether there are fundamental differences in cognitive development between students in different curricula at the community college, and to examine why these differences arise, if they indeed exist.

In order to answer the questions posed, this study will determine the cognitive levels of students in two curricula [Liberal Arts (LA) and Laboratory Technology (LT)] upon entering the community college, and will attempt to measure any changes in cognitive level after attending the community college for one year. This research is a natural field study which involves both pretesting and posttesting as well as group intervention techniques.

Cognitive level will be measured using the theory of cognitive development as proposed by Jean Piaget (Inhelder, Piaget, 1958). Piaget is recognized by most educators as an authority on the general intellectual development of individuals. His numerous books and articles (Piaget, 1962, 1969, 1972) as well as his

hierarchy of stages of intellectual development has been used and confirmed by many researchers in the field of science education.

TASKS USED IN THE STUDY

| Combinatorial Tasks | | Proportional Tasks | |
|---|---|---|---|
| 1. | Chemical combinations | 7. | Inclined plane |
| 2. | Electrical board form of chemical combinations | 8. | Mr. Short |
| 3. | Change task | 9. | Balance |
| 4. | Cities task | 10. | Shadows |
| 5. | Fruit salad | 11. | Recipe |
| 6. | License plate task | 12. | Longeot proportions |

Hypotheses under test

Hypothesis 1a. On the average, the performance of Laboratory Technology students on tests involving combinatorial reasoning will not change after one year of a community college education.

Hypothesis 1b. On the average, the performance of Laboratory Technology students on tests involving proportional reasoning will not change after one year of a community college education.

Hypothesis 2a. On the average, the performance of Liberal Arts students on tests involving combinatorial reasoning will not change after one year of a community college education.

Hypothesis 2b. On the average, the performance of Liberal Arts students on tests involving proportional reasoning will not change after one year of a community college education.

Hypothesis 3a. On the average, the performance of laboratory technology students and liberal arts students will be the same on tasks involving combinatorial reasoning, upon entering the community college.

Hypothesis 3b. On the average, the performance of laboratory technology students and liberal arts students will be the same on tasks involving proportional reasoning, upon entering the community college.

Hypothesis 4a. On the average, the performance of laboratory technology students and liberal arts students will be the same on tasks involving combinatorial reasoning, after completing one year of community college education.

Hypothesis 4b. On the average, the performance of laboratory technology students and liberal arts students will be the same on tasks involving proportional reasoning, after completing one year of community college education.

## Statistics

Hypothesis 1a) By subject using the McNemar test, for significance of changes

L.T. precomb vs postcomb, N = 28

| | conc. post | trans-formal post |
|---|---|---|
| trans-formal pre | 5 | 7 |
| conc. pre | 10 | 6 |

| | |
|---|---|
| A | B |
| C | D |

Test Statistic: $\chi^2 = \frac{(|A-D|-1)^2}{A+D}$ with d.f. = 1

$$\chi^2 = 0$$

For $\alpha = 0.05$, d.f. = 1, $\chi^2 \geq 3.84$

Fail to reject hypothesis 1a.

Hypothesis 1b) By subject using the McNemar test.

L.T. preprop vs postprop, N = 28

| | conc. post | trans-formal post |
|---|---|---|
| trans-formal pre | 1 | 8 |
| conc. pre | 8 | 11 |

$$\chi^2 = 6.75$$

For $\alpha = 0.01$, d.f. = 1, $\chi^2 \geq 6.63$

Reject hypothesis 1b.

Hypothesis 2a) By subject using the McNemar test, N = 29

L.A. precomb vs postcomb

| | conc post | trans-formal post |
|---|---|---|
| trans-formal pre | 3 | 9 |
| conc. pre | 12 | 5 |

$$\chi^2 = 0.125$$

For $\alpha = 0.05$, d.f. = 1, $\chi^2_Z$ 3.84

Fail to reject hypothesis 2a.

Hypothesis 2b) By subject using the McNemar test, N = 29

L.A. preprop vs post prop

| | conc post | trans-formal post |
|---|---|---|
| trans-formal pre | 3 | 2 |
| conc pre | 20 | 4 |

$$\chi^2 = 0$$

For $\alpha = 0.05$, d.f. = 1, $\chi^2_Z$ 3.84

Fail to reject hypothesis 2b

By subject
Hypothesis 3a) Precomb tasks for LA and LT, N = 80

| | conc. | trans-formal |
|---|---|---|
| L.A. | 23 (.58) | 17 (.42) |
| L.T. | 20(.50) | 20 (.50) |

Test statistic: $\chi^2 = \frac{n(|AD - BC| - n/2)^2}{(A+B)(C+D)(A+C)(B+D)}$

$\chi^2 = 0.201$

For $\alpha = 0.05$, d.f. = 1, $\chi^2 \geq 3.84$

Fail to reject hypothesis 3a.

Hypothesis 3b) By subject, preprop tasks for LA and LT, N = 80

| | conc. | trans-formal |
|---|---|---|
| L.A. | 34(.85) | 6 (.15) |
| L.T. | 27(.67) | 13 (.33) |

$\chi^2 = 2.48$

For $\alpha = 0.05$, d.f. = 1, $\chi^2 \geq 3.84$

Fail to mject hypothesis 3b.

Hypothesis 4a) By subject, postcomb tasks for LA and LT, N = 57

| | conc. | trans-formal |
|---|---|---|
| L.A. | 15(.52) | 14(.48) |
| L.T. | 15(.54) | 13(.46) |

$\chi^2 = 0.158$

For $\alpha = 0.05$, d.f. =1, $\chi^2 \geq 3.84$

Fail to reject hypothesis 4a.

Hypothesis 4b) By subject, postprop tasks for LA and LT, N = 57

| | conc. | trans-formal |
|---|---|---|
| L.A. | 23(.79) | 6 (.21) |
| L.T. | 9(.32) | 19 (.68) |

$\chi^2 = 11.03$

For $\alpha = 0.005$, d.f. = 1, $\chi^2 \geq 7.88$

Reject hypothesis 4b.

Results

One of the main purposes of this study was to determine if college itself could act as a type of intervention in raising the cognitive level of students. Other studies have indicated that more than 50% of entering college freshman operate at the concrete level of thought (McKinnon and Renner, 1971). The data in this study support those findings. On the precombination tasks 58% of the liberal arts students and 50% of the laboratory technology students were concrete. On the preproportional tasks, 85% of the liberal arts students and 67% of the laboratory technology students were concrete. It was the purpose of this study to determine if these two very different curricula could have some effect on changing the cognitive level of its students.

The reader should remember that the laboratory technology curriculum is a career oriented course of study with intensive training in science and mathematics. The course of study during the first year includes courses in chemistry, biology, physics and college mathematics. The liberal arts curriculum, on the other hand, is a general education curriculum, for students who wish to transfer to upper division colleges. The students take no science or mathematics courses during the first year.

One might expect that these two groups of students would have very different abilities, even upon entering the community college. However, it was shown in this study that both groups of students performed at the same level on the combinatorial and proportional pretests. Therefore, in terms of their cognitive abilities on Piagetian tasks both groups of students were statistically identical.. This proved to be an interesting fact in terms of the overall outcome of the study, because on the post-testing, although there was no significant difference on the combinatorial tasks, there was a significant difference on the proportional tasks between the two groups. The LT group scored much higher on the postproportions than the LA group.

In other words, the most significant change observed for subjects in this study was the proportional reasoning ability of the laboratory technology students. The laboratory technology students showed better performance on the postproportions than on the preproportions. In fact, the percentage of laboratory technology students scoring in the transitional-formal category increased from 33% on the pretests to 68% on the posttests. Keeping in mind that both the laboratory technology group and liberal arts group were of equal ability on the preproportions, but not on the postproportions, one might conclude that the laboratory

technology curriculum did have the effect of increasing the cognitive level (in proportional reasoning) of students in that curriculum. This result is significant because many intervention studies attempting to raise cognitive level report no change in cognitive development due to the intervention. (See Neimark, 1975 and Bady, 1978 for reviews of the literature.)

How can one account for the gain in proportional reasoning ability for LT students? The data suggest the following explanation. Proportional reasoning is taught in all science courses and some mastery of this schema is necessary to pass these courses. It is reasonable to expect that students who do not attain some minimal skill in proportional reasoning will not finish the year in the LT curriculum. Instead they will "flunk out" or change to a different curriculum. This explanation accounts for some of the subjects who dropped out of the study. It is also reasonable to infer that the LT curriculum acts as both an intervention and filtering mechanism. Students who have a certain minimum intellectual ability may be helped by the LT curriculum to improve this ability, as regards proportional reasoning, whereas, students who fall below this minimum ability leave the curriculum.

Future investigations will attempt to validate and expand upon the present study.

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